NASA Technical Memorandum

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DETERMINATION OF SOLID ROCKET MOTOR (SRM) CASE SEGMENT GROWTH

By Lisa Hanks Mitchell

Materials and Processes Laboratory Science and Engineering Directorate

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TECHNICAL MEMORANDUM

DETERMINATION OF SOLID ROCKET MOTOR (SRM) CASE SEGMENT GROWTH

INTRODUCTION AND PURPOSE

The purpose of this investigation was to assess dimensional changes in the Solid Rocket Motor (SRM) case segments as a result of multiple hydroproofs and flight uses. Two segments (S/N 0000022 and S/N 0000056) were shipped to Rohr Industries in San Diego so that measurements taken at final machining buy off could be exactly duplicated. In addition, two new lightweight case segments (S/N 00000121 and S/N 00000122) were hydroproofed once at Rohr, measured and sent to Morton Thiokol, Clearfield, Utah, for further hydroproof testing and remeasuring. Of most interest was any dimensional change in the vicinity of the tang and clevis which could have an adverse effect on O-ring squeeze.

PROCEDURE

This assessment was based on the evaluation of four SRM case segments. Two case segments, S/N 0000022 and S/N 0000056, had been exposed to prior uses and two case segments, S/N 00000121 and S/N 00000122, were new. See Table 1 for S/N 0000022 and S/N 0000056 specific stack placement history.

Case segment S/N 0000022, exposed to five prior uses, and case segment S/N 0000056, exposed to four prior uses, were mounted and measured on the tooling setups used initially at Rohr during machining. These tools placed the cases in a near true rounded condition so comparison data could be taken. All original measurements made for buy off final machining were repeated at the same locations and recorded. The same pi tape used for the original readings was furnished by Rohr for this investigation. All measurements were performed by skilled personnel, witnessed by on-site MSFC and Thiokol assessment engineers, and verified by resident Rohr quality control personnel.

Case segments S/N 00000121 and S/N 00000122, both new cases, were hydroproofed once at Rohr and all original measurements were repeated and recorded. These segments were then shipped to Morton Thiokol, Clearfield, hydroproofed five more times with case measurements being taken after each hydroproof. These measurements were also performed by skilled MTI quality personnel and witnessed by MSFC, Thiokol and Rohr assessment engineers.

All diameter readings were made using pi tapes, accurate to ± 0.002 in. The same pi tape, S/N 81300, was used to take the measurements at Rohr and Morton Thiokol (Figs. 1 and 2). The measurement procedure, as outlined in MTI Department Instructions DI-I-277, was used at both Rohr and MTI. Horizontal length measurements were taken using a tesamike while an English micrometer was used for vertical length measurements. Thickness measurements were taken with a deep throat micrometer with an accuracy to ± 0.001 in. A Federal Bore Gauge, with accuracy ± 0.001 in., was used to take gap readings (Fig. 3).

RESULTS

The clevis and tang both show positive dimensional changes in the sealing surface areas. The average tang thickness on segments S/N 0000022 and S/N 0000056 was less than that originally recorded by Rohr. The O-Ring clevis gaps on all four SRM case segments show positive dimensional growth (Figs. 4 and 5). Figure 6 and Table 2 shows the growth after each hydro for the new case segments, S/N 00000121 and S/N 00000122, in the unrestrained condition.

TABLE 1. S/N 0000022 AND S/N 0000056 CASE SEGMENT HISTORY

<u>s/N</u>	1 22		<u>S/N 56</u>
6 h	ydro		5 hydro
3 f	lights		3 flights
2 s	tatic		l static
Flight DM 3:4	Position	Flight	Position
	Aft Fwd - Ctr	-	-
QM 3:4	Aft Fwd - Ctr	QM 1:3	Fwd Fwd - Ctr
SRM 5A:2	Aft Fwd	SRM 3B:3	Fwd Fwd - Ctr
	Fwd Fwd	SRM 13A:1	Fwd Fwd
SRM 22B:1	Fwd Fwd	SRM 22A:1	Fwd Fwd
OM - qualifica	tion static firing		

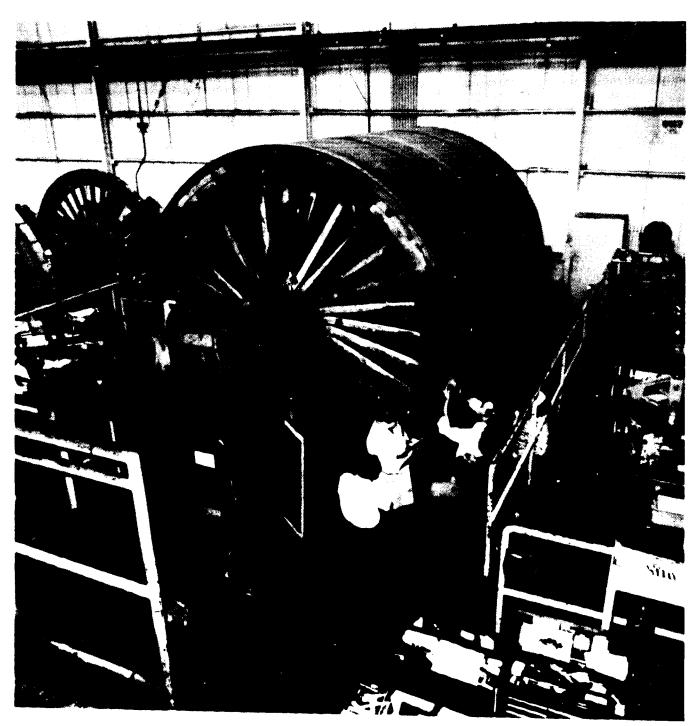


Figure 1. Pi tape measuring (restrained).



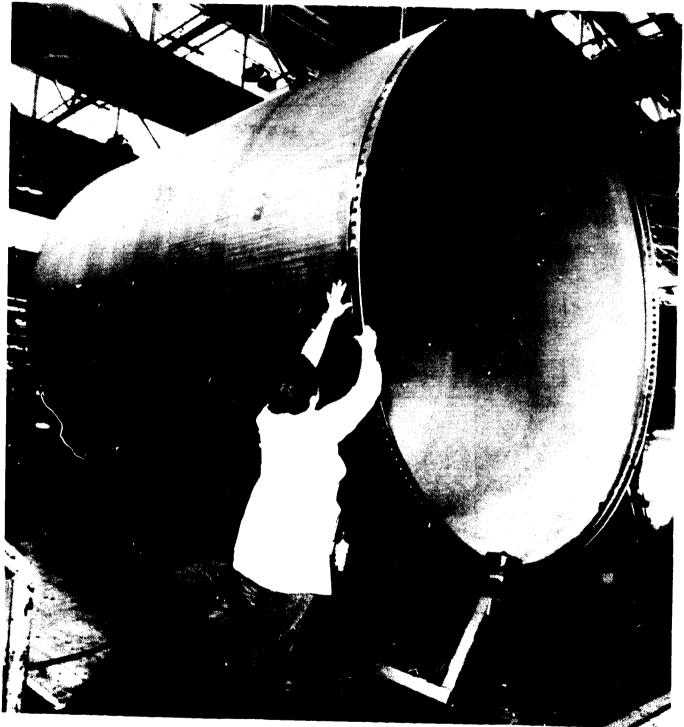
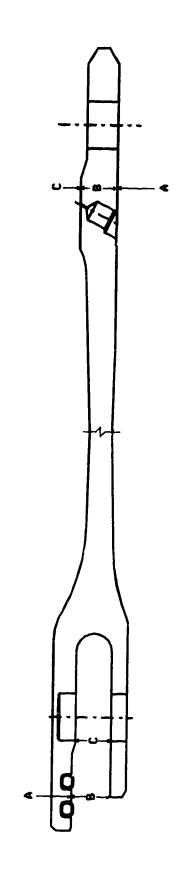


Figure 2. Pi tape measuring (unrestrained).



Figure 3. Clevis gap measuring.



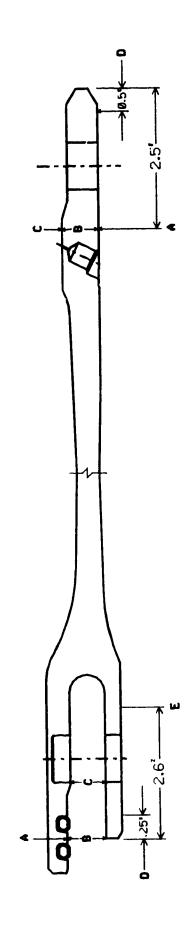
CLEVIS END RESTRAINED

	S/N	S/N 0000022	21	S/N	S/N 0000056	و
NEASURENENT LOCATION	ROPE ORIGINAL	AFTER 5 USES	DELTA	ROFF	AFTER 4 USES	DELTA
CLEVIS DIA AT O/R (A)	144.561	144.595	_	144.563	144.595	+832
CLEVIS GAP AVG O/R (B)	9 833	.8389	+.8659	+.0059 8368	.8427	+. 986 9
CLEVIS GAP AVG INNER (C)	.7518	9737.	+.9852 .7545	.7545	.757	+.0825

TANG END RESTRAINED

	N/S	S/N 0000022	2	S/N	S/N 0000056	56
MEASURENENT LOCATION	ROPE ORIGINAL	AFTER ROHR	DELTA	ROFF ORIGINAL	AFTER DELTA	DEL TA
TANG OD MACH SURFACE (A)	146.137	146.158 +. EZ1 146.142 146.162 +. EZ8	128.	146.142	146.162	828
TANG AVERAGE THICKNESS (B)	.78425	7867.	96.88	3087. 3088	.7823	
TANG ID SEAL SURFACE (C)	144.5685	(C) 144.5685 144.5966 + #281 144.575144.5974 + #224	+.6281	144.575	144.5974	+2224

Figure 4. Case dimensional measurement at Rohr, $\rm S/N~0000022$ and $\rm S/N~0000056$ (restrained).



CLEVIS END RESTRAINED

	S/N	S/N 00000121	-	N/S	S/N 00000122	Ŋ
MEASURENENT LOCATION	ROFF ORIGINAL	AFTER 6 HYDRO'S DELTA	DELTA	ROFF ORIGINAL	AFTER 6 HYDRO'S	DELTA
CLEVIS DIA AT O/R (A)	144.571	144.587	+.016	144.564	144.586	+.822
CLEVIS QUTER LEG .25° (0)	146.984	146.930	9Z 6 '+	146.895	146.927	+1935
CLEVIS CUTER LEG 2.6 AFT (E) ENO	146.983	146.914	1187+	146.898	146.989 +.811	÷
CLEVIS CAP (B)	.8320	19367	+.8647	16281	8327	+.6636
CLEVIS GAP AVG INDER (C)	1967.	.7564	+,0063	.7514	.7514	•

TANG END RESTRAINED

	S/N 6	S/N 00000121	1	S/N (S/N 00000122	22
MEASURENENT LOCATION	ROFR ORIGINAL	AFTEX 6 NELTA ORIGINAL	DELTA	ROHR ORIGINAL	AFTER 6 HYDRO'S DELTA	DELTA
TANG .5' (D) 146.149	146.149	146.175	+.826	+.826 146.149	146.177	+ B 28
TANG OD SEAL SURFACE (A)	146.146	146.161	+.615	+.815 146.146	146.163	+.B 17
TANG AVERAGE THICKNESS SEAL SURFACE (B)	.788	.787	001	7967.	787.	
TANG 10 SEAL SURFACE (C)	144.570	144.570 144.587		+.017 144.565	144.588 +.523	+#23

Figure 5. Case dimensional reassessment at Rohr, S/N 00000121 and S/N 00000122 (restrained).

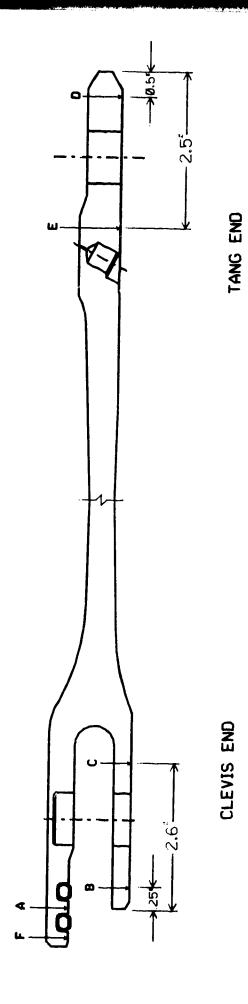


Figure 6. Unrestrained case dimensional locations (see Teble 2).

TABLE 2. UNRESTRAINED CASE COMPARISON

SERIAL *	כר	CLEVIS END BETW O/R 'A' DIMENS	END BETWEEN	VEEN	TANG 'E' D]	ANG SEAL SURFAC	SURFACE ION (IO)		CLEVIS (.25')	00 .8.	EVIS OD OUTER LEG	S F
	PRE HYDRO	HYDRO *	POST HYDRO	DELTA	PRE HYDRO	HYDRO *	POST HYDRO	DELTA	PRE HYDRO	HYDRO *	POST HYDRO	DELTA
00000121	144.571	7	144.530	+.009	144.570	Ţ	144.580	+.010	146.904		146.920	+.016
·	144.577	7	144.583	900.+	144.580	2	144.582	+.002	146.922	2	146.925	+.003
	144.583	က	144.585	+.002	144.582	3	144.581	001	146.925	٣	146.929	+.004
	144.585	4	144.584	001	144.581	4	144.581	9	146.929	4	146.927	002
	144.584	വ	144.586	+.002	i44.58i	5	144.582	+.001	146.927	വ	146.928	+.001
	144.586	9	144.584	002	144.582	9	144.583	+.00i	146.928	9	146.928	0
		CUM		+.016		CUM		+.013		CUM		+.022
00000122	144.564	Ţ	144.583	+.019	144.565	1	144.576	+.011	146.895	1	146.917	+.022
	144.582	2	144.582	0	144.574	2	144.581	100°+	146.917	2	146.919	+.002
	144.582	~)	144.581	001	144.581	3	144.583	+.002	146.919	٣	146.922	+.003
	144.581	4	144.584	+.003	144.583	4	144.582	001	146.922	4	146.923	+.001
	144.584	5	144.584	0	144.582	5	144.583	+.001	146,923	വ	146.924	+.001
	144.584	9	144.584	0	144.583	9	144.583	0	146.924	9	146.922	002
		CUM		+.02i		CUM		+.020		W D D		+.027
0000022	144.561	5	144.595	+.034	144.569	5	144.597	+.028				
ааааазе	144.563	4	144.595	+.032	144.575	4	144.597	+.022				

TABLE 2. (Concluded)

SERIAL *		CLEVIS OUTER LEG 'C' DIMENSION		2.6'	71	TANG .5' I	ANG .5' FROM END	2 6	CLEVI	CLEVIS FOWARD OF O-RING 'F' DIMER	VIS FOWARD OF PRIM	PRIMARY USION
	PRE HYDRO	HYDRO *	POST HYDRO	DEL TA	PRE HYDRO	HYDRO *	POST HYDRO	DELTA	PRE HYDRO	HYDRO *	POST HYDRO	DELTA
00000121	146.903	1	146.910	+.007	146,149	-1	146.164	+.015		1		
	146.909	2	146.912	+,003	146.166	2	146.171	+.005	144.581	2	144.583	+.002
	146.912	3	146.913	+.001	146.171	3	146.173	+.002	144.583	3	144.585	+.002
	146.913	4	146.912	201	146.173	4	146.173	0	144.585	4	144.585	0
	146.912	5	146.913	+.001	146.173	5	146.172	100	144,585	ည	144.585	0
	146.913	9	146.913	0	146,172	9	146,173	+.001	144.585	9	144.585	0
		CUM		+.011		WN3		+.022		CUM		+.004
00000122	146.898		146.910	+.012	146.149	7	146.166	+.017		1.		
	146.903	2	146.907	+.004	146.166	2	146.173	+.007	144.582	2	144.583	+.001
	146.907	η	146.908	+.001	146.173	3	146.175	+.002	144.583	ო	144.584	+.001
	146.90/8	4	146.907	00i	146.175	4	146.175	0	144,584	4	144.585	+.001
	146.907	5	146.907	0	146.175	വ	146.175	Ø	144.585	5	144.585	0
	146,907	9	146.908	+.001	146,175	9	146,176	+.001	144.585	9	144.585	9
		CUM				CUM		+.027		CUM		+.003
0000002					146.137	5	146,182	+.045				
00000056					146.142	4	146.193	+.051				

APPROVAL

DETERMINATION OF SOLID ROCKET MOTOR (SRM) CASE SEGMENT GROWTH

Lisa Hanks Mitchell

The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

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